WASHBURN & GILLIS ASSOCIATES LTD.

91-05339/

ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED CAVENDISH FARMS EXPANSION

SUBMITTED TO:

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Mr. Ginger Breedon
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Dear Mr. Breedon:

RE: Environmental Impact Statement for the Proposed Cavendish Farms Expansion

Please find enclosed our report entitled, "Environmental Impact Statement for the Proposed Cavendish Farms Expansion. The report is the culmination of the Environmental Impact Assessment for the proposed project. It provides summaries of the project description, project setting, and findings of our environmental studies.

We have enjoyed working with all participants on this project, and would be pleased to discuss any aspect of our studies.

Yours very truly,

Robert Hutt

Robert Hutt, P.Eng.,
Vice-President

JAS/pdw

enclosure

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1.0 SUMMARY AND PRINCIPAL FINDINGS

This document comprises a summary of the Environmental Impact Assessment (EIA) studies for the proposed Cavendish Farms expansion at New Annan, Prince Edward Island. The EIA was conducted at the request of the Prince Edward Island Department of Environment (PEI DOE). The purpose of the EIA was to address a series of environmental concerns identified by the PEI DOE with respect to the expansion.

Chapter 2 of this document provides an introduction to the EIA by defining the project as two distinct but related components. These are the expansion of the process plant itself and expansion of the associated wastewater treatment plant. This section session discusses the environmental issues related to both components of the project, and describes the approach taken in the EIA study.

Chapter 3 gives information concerning both components of the proposed expansion. Also described in this section are projects identified and proposed to modernize the existing process plant and wastewater treatment plant.

Chapter 4 describes the project setting. The purpose of this section is to provide line information on which to base subsequent analyses and predictions. The setting is described in terms of the terrestrial environment, marine/estuarine environment, freshwater environment, and existing sources of aquatic pollution.

Chapter 5 summarizes the findings of the environmental studies.

The principal findings of the Environmental Impact Assessment are given as follows:

1. Process Plant Expansion

Additional fuel oil will be required for steam production in the expanded plant. Electrical supplies to the existing facility will be sufficient.

Boiler plant, process plant, odorous, and noise emissions will all increase with the expansion, but will remain within guidelines and regulations.

An expanded wastewater treatment plant will be designed and constructed to ensure that effluent discharge remain within regulations and protect the ecology of the receiving waters.

Hazardous substances inventories at the plant will not increase, nor will the number of petroleum storage tanks.

Residual environmental concerns such as lagoon usage, landfill development, waste fat handling, silt and stone handling, and refuse collection will all be addressed.

2. Groundwater Evaluation

Baseflow will be sufficient to provide recharge to the existing Cavendish Farms production wells.

No additional well development will be necessary with the expansion.

No impact on aquaculture, recreational fishery, recreation, agriculture, or aquatic habitat in general is expected.

Factors that may affect groundwater quality with the recharge area are identified. It is recommended that a wellfield protection area of radius 500 metres is established to protect the quality of groundwater with the Cavendish Farms wellfield.

3. Site Selection for Effluent Outfall Location

Construction and operation impacts were considered in the evaluation of four possible effluent outfall location.

It was concluded that placement of the effluent outfall is in either Webber Cove or the Barbara Weit Estuary would result in fewer impacts to valued ecosystem components then placement in either the Northumberland Strait or the Gulf of St. Lawrence. Further study the first two alternatives was recommended.

4. The Assimilative Capacity of the Barbara Weit Estuary

Water quality modelling, and analyses of field data and observations were used to describe the impacts of the existing wastewater treatment plant on the Barbara Weit Estuary and Webber Cove. Further modelling was completed to determine the placement of the outfall from a proposed expanded wastewater treatment plant in the Estuary or Cove.

It was determined that normal and upset discharges from the existing wastewater treatment plant contribute to the unfavourable conditions presently experienced in the Estuary. Parameters of concern were identified as BOD, nutrients and ammonia, coliforms, and suspended solids.

Subsequent modelling indicated that an improved effluent discharge to either the Estuary or Cove would improve conditions in both areas. Although the Cove area discharge suggested a better improvement with normal discharges of BOD and nutrients the Estuary discharge of improved effluent suggested better improvements in coliforms and suspended solids. The Cove area discharge alsc presented a number of uncertainties.

It was recommended the effluent outfall from the proposed expanded wastewater treatment plant be placed in the Barbara Weit Estuary.

2.0 INTRODUCTION

2.1 Project Definition and Rationale

Cavendish Farms is a registered company backed by the management and financial resources of the Irving organisation. Cavendish Farms proposes to expand the production capacity of the french fry lines in its plant near New Annan, Prince Edward Island (Figure 2-1). The main objectives of this expansion are to increase production to meet market demands, and to provide flexibility in the types of french fry products produced.

The company has over recent years conducted feasibility studies to determine how to add production capacity to its operations. The options for expansion are essentially to expand existing facilities at New Annan, or to construct new facilities at some other location on or off the Island. With the closure of Canadian Forces Base Summerside, additional emphasis was placed on an Island development. Cavendish Farms was eager to participate in reducing the impact of the Base closure on the local economy.

In accordance with the Environmental Protection Act, Cavendish Farms has submitted a proposal to the Prince Edward Island Department of Environment (PEI DOE) entitled "Proposal for Expansion of Existing French Fry Operation" (May, 1990). In this proposal, Cavendish Farms outlines their expansion plans with respect to physical plant additions, construction, and operations. They also discuss environmental concerns of the project, and note that the schedule for the expansion may vary pending completion of the environmental review process.

In preparation of their proposal and in consultation with the PEI DOE, Cavendish Farms has identified two distinct but related components to the project. The first was the expansion of the process plant itself. The second involved alterations, expansion, or reconstruction of the waste water treatment plant associated with the facility.

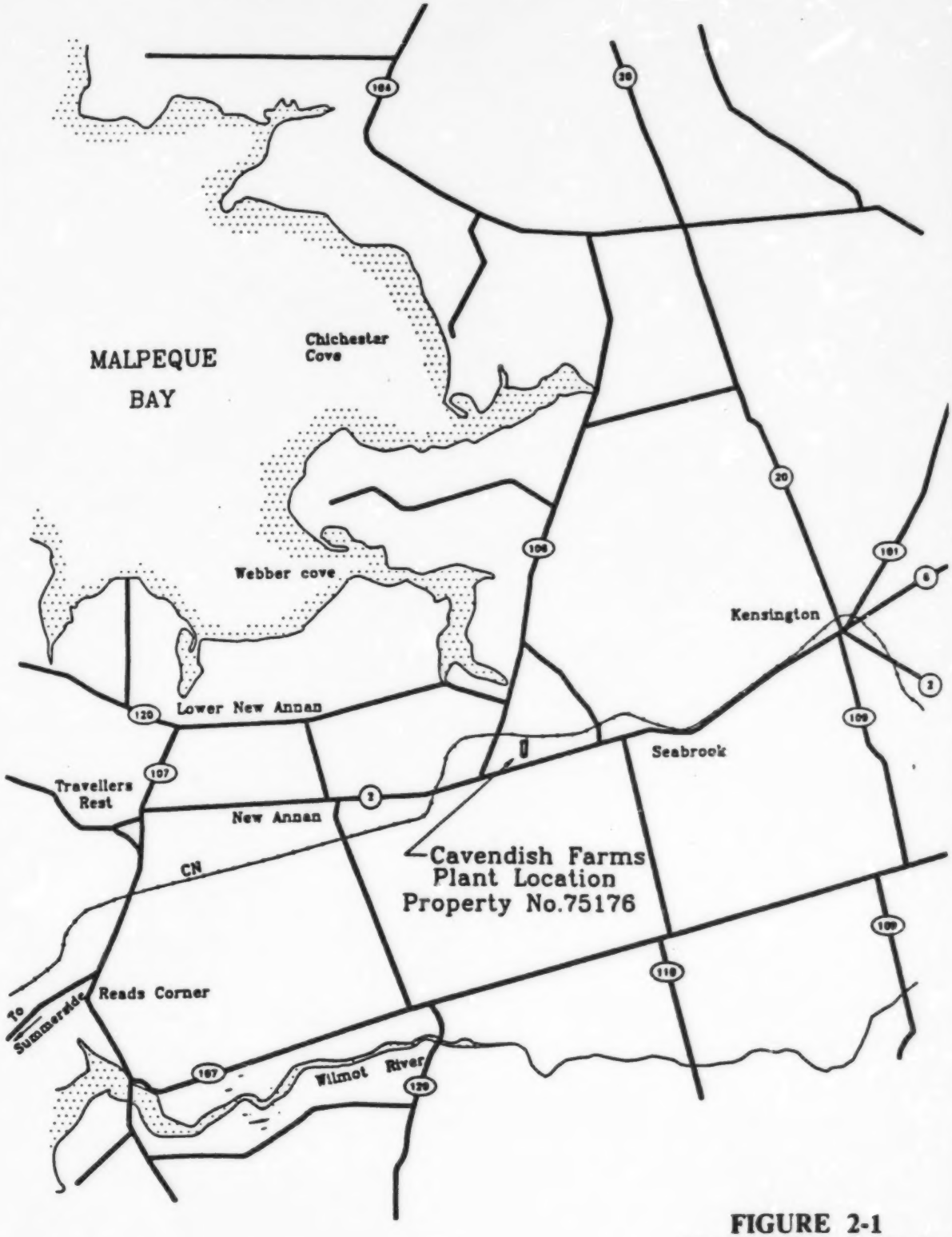

FIGURE 2-1
CAVENDISH FARMS
PLANT LOCATION

2.2 Environmental Issues

A number of environmental concerns have been raised in connection with the proposed Cavendish Farms expansion. The Prince Edward Island Department of Environment (PEI DOE) prepared a list of preliminary environmental issues considered relevant to the project. This list was concerned with three categories of information: (i) aspects of the process plant expansion and operation, including construction impacts, air quality and noise, petroleum and hazardous substances handling and storage, and energy requirements; (ii) aspects of the groundwater supply, including availability, quality, and impact potential; and (iii) aspects of waste water discharge, including a description of the receiving environment, physical and chemical characteristics of the waste water, and potential impacts of the discharges. The PEI DOE later indicated concerns to do with the location of the outfall from the wastewater treatment plant, and requested that alternative locations be considered.

The PEI DOE has stated that an Environmental Impact Assessment (EIA) that would address the listed concerns must be completed before approval for the project could be granted.

2.3 Approach to the Environmental Impact Assessment

Washburn & Gillis Associates Ltd. (WGA) were retained as consultants to undertake the studies necessary to complete an Environmental Impact Assessment (EIA). WGA were directed to complete the EIA in a manner that would address the issues listed by the PEI DOE.

By agreement between Cavendish Farms and the Provincial Government of Prince Edward Island, two proponents for the project were identified. Cavendish Farms became the proponent for aspects of the project involving the process plant expansion and the groundwater supply. Environmental Industrial Services Inc. (EISI), a crown corporation

which will own the waste water treatment plant at the facility, became the proponent for aspects of the project involving waste water treatment and discharge. As such, the proponents became clients to WGA for related components of the EIA.

The EIA was completed by a diverse team of specialists representing various disciplines. The team comprised specialists in the fields of fisheries and environmental management, waste management, water quality modelling, groundwater assessment, and process engineering. The team worked in close association with representatives of Cavendish Farms and Environmental Industrial Services Inc., as well as design engineers from ADI Ltd., and Stanley Associates Engineering Ltd. The EIA was completed under the guidance and authority of a Technical Review Committee. The Committee consisted of representatives from the PEI DOE, the PEI Department of Fisheries and Aquaculture (PEI DFA), the federal Department of Fisheries and Oceans (DFO), and Environment Canada (EC).

The technique employed in the EIA was modified from that suggested by Beanlands and Duinker (1983) in the report entitled "Ecological Framework for Environmental Impact Assessment in Canada". This approach uses valued ecosystem components (VEC's) as the focal points for impact assessment. These could include: (i) components important to humans commercially; (ii) components which may be important socially; (iii) components which may be essential to the food web; or, (iv) components which may be a reliable indicator of environmental change. Although VEC's may not be explicitly stated or defined, an approach following this concept can add focus and direction to an EIA.

The studies were initially designed to produce three final reports. These final reports have been completed as Volumes 1, 2, and 3 of the EIA and are entitled:

Volume 1: Environmental Review of the Process Plant Expansion;
Volume 2: Groundwater Evaluation; and
Volume 3: A Review of the Assimilative Capacity of the Barbara Weit Estuary.

A fourth final report has also been completed. The studies necessary for this final report were undertaken to address concerns raised by the Technical Committee that areas other than within Malpeque Bay should be considered for locating the waste water treatment plant effluent outfall. This report is entitled:

Site Selection Report - Effluent Outfall Location for the Proposed Expansion of the Cavendish Farms Plant.

The present document, the Environmental Impact Statement (EIS), comprises a summary of the information contained in each of the four final reports. Information from these final reports is assimilated and presented in a manner as to guide the reader through the overall EIA process. The EIS is structured into the following chapters: Chapter 1 gives a summary of the principal findings of the EIA; Chapter 2 gives an introduction to the project and the EIA process; Chapter 3 describes the two main components of the project, the process plant expansion and alterations to the waste water treatment plant; Chapter 4 describes the environmental setting of the project; and, Chapter 5 gives the findings of the environmental studies.

3.0 PROJECT DESCRIPTION

3.1 Process Plant Expansion

The Cavendish Farms process plant expansion is required to meet increasing customer demands and allow the Company to remain competitive on a global basis.

Last fall (Sept. 1990) the Company announced its plans to modernize the New Annan plant through upgrading an existing french-fry line that was 15 years old. Also included in the modernization project was a building addition to house new offices, employee locker rooms and an employee cafeteria.

Cavendish Farms is prepared to proceed with expansion and the addition of a new line of potato products. No adverse environmental problems are anticipated since the majority of the construction involves installation of equipment into an existing structure.

The production capacity of the fully expanded plant will be about 40% greater than present levels. This increase will represent an approximate annual increase in raw product from 196,000 tonnes to 273,000 tonnes.

3.2 Waste Water Treatment Plant Expansion

In their proposal of May, 1990, Cavendish Farms noted that the main environmental issue to be addressed in the expanded french fry operations is the treatment of process waste water. The waste water from the existing process plant is presently treated in a facility

operated by Northeast Energy Services Ltd. (NESL). The PEI DOE and NESL confirm that discharges from the existing waste water treatment plant are within the current Federal Guidelines. However, it is also acknowledged that these Guidelines are not providing an adequate level of protection for the waters receiving these discharges, namely the Barbara Weit Estuary. Cavendish Farms has proposed that new effluent guidelines and objectives be established for the expanded process plant.

Portions of the EIA were directed at studying the assimilative capacity of the Barbara Weit Estuary (see Chapter 5 of this document). These studies described the existing conditions in the Estuary, and how discharges from the existing NESL waste water treatment plant may contribute to these conditions. Further, these studies established and evaluated criteria for an improved effluent that, if discharged to the Barbara Weit Estuary, would alleviate the environmental problems presently occurring there.

Environmental Industrial Services Inc. (EISI) is responsible for designing and construction of an expanded waste water treatment plant at New Annan. This expanded treatment facility will produce a final effluent of quality equal to or better than that recommended by the environmental studies. To this end, design proposals for the treatment plant have been submitted by ADI (July, 1990) and Stanley Associates Engineering Ltd. (January, 1991). Although, final design work is yet to be completed, design criteria have been identified and are presented in section 5.4.4.2 of this document. The expanded waste water treatment plant is expected to be on line by the autumn of 1992.

3.3 Modernization of the Process and Waste Water Treatment Plants

Cavendish Farms and Northeast Energy Services Limited have proposed a series of interim projects with the combined goal of improving the final effluent discharge from the existing treatment facility. Albeit not an ultimate solution, it is felt that the steps described below

will help to improve the environmental conditions of the Barbara Weit Estuary, before the expanded waste water treatment plant comes on line.

Modernization of the potato processing procedure will involve installation of a system to remove peel waste at the scrubbers, thereby preventing it from entering the waste water stream. Cavendish Farms estimates that completion of this alteration will result in a reduction in chemical oxygen demand (COD) and suspended solids (SS) loadings to the waste water treatment facility of at least 20%. Concurrent with this, the company plans to reduce its overall water usage. As a result, it is anticipated that the weekly averaged hydraulic flow from the processing plant to the waste water treatment plant will not exceed 4900 m^3/day.

Northeast Energy Services Limited has proposed an upgrading of the existing waste water treatment facility. The goal of the upgrade is to produce a final effluent of better quality than is presently discharged to the Barbara Weit Estuary. The upgrading will involve modifications and new equipment purchases.

Proposed modifications to the waste water treatment facility include repairs to the vacuum filter system, modifications to the bulk volume fermenter (BVF) cover, and refurbishment of man-hole covers and one sump.

Repairs to the vacuum filter system would result in the ability of the facility to remove and dewater waste activated sludge (WAS), and subsequently use this material as land fertilizer. This would result in a significant reduction in the total COD sources and SS in the system, and therefore the final effluent.

Presently about 5% of the BVF reactor is not covered. Complete coverage of the BVF would improve biogas collection and reduce the incidence of foul odour discharge. Refurbishment of the man-hole covers would provide a similar result.

NESL proposes to modify the structure of the return anaerobic sludge piping so that it discharges directly to the influent pumping station. This modification to the BVF would increase the amount of anaerobic sludge that could be recycled during normal operation. Therefore, the efficiency of the treatment system would be improved.

Proposed new equipment purchases include additional floating aerators and two polymer feed systems.

Installation of the additional aerators could be accomplished during full operation. The full suite of aerators could be operated in sequences that would result in increased BOD removal, improved ammonia removal, as well as improved total nitrogen removal. The quality of the final effluent would therefore be improved.

The installation of polymer feed systems in two areas of the facility would contribute to an improvement in effluent quality. One system is proposed to work in conjunction with the vacuum filter system (described above) to facilitate SS and COD source loadings removal. The second system is proposed to be installed at the final clarifier to improve the removal of solids in this component.

4.0 PROJECT SETTING

4.1 Terrestrial Environment

This section provides an overview of the terrestrial environment for the project. Included in this summary are aspects of topography and geology, vegetation, wildlife and waterfowl resources, agriculture and industry, and recreation and tourism.

4.1.1 Topography/Geology

The topography of the Webber Cove/Barbara Weit drainage basin consists of gently sloping land to Malpeque Bay. The bedrock geology of the basin is characterized by Upper Pennsylvannian to Middle Permian age red beds composed of varying amounts of sandstone, siltstone, claystone, intraformational breccias and conglomerates. The bedrock of PEI is covered by a layer of unconsolidated glacial material, ranging from a few centimetres to several metres in thickness.

Although few detailed geological studies have been conducted on Prince Edward Island, reports indicate that bedrock in the vicinity of the study area is flat lying to sub-horizontal. Alternating layers of siltstone and sandstone to depths of 137 metres have been determined.

The aquifer consists of a fractured porous sandstone media. Groundwater movement within the aquifer is predominantly controlled and confined by fracture characteristics including spacing, degree of interconnection, and aperture distribution.

4.1.2 Vegetation

The majority of the land encompassed by the Webber Cove and the Barbara Weit River watershed is used for agricultural purposes. Various wooded areas exist along the Barbara

Weit and other nearby rivers, on sections of the shore of Webber Cove and also inland, between agriculture fields. Several meadows, marshes and swamps are also present. To date, no field studies have been undertaken to investigate the presence of rare plant species within the study area.

4.1.3 Wildlife and Waterfowl Resources

The proximity of fresh and marine water bodies, agricultural lands, meadows, swamps, marshes and various types of forest stands within the study area provide potential habitat for numerous wildlife and waterfowl species. Nine wetland sites of significant wildlife value were identified by the PEI Department of Environment within the study area, five of which were identified downstream from the junction between the southern branch of the Barbara Weit River and Highway #2.

Large numbers of Canada geese utilize the region during their spring and fall migrations. Other waterfowl species have also been observed, such as black duck, goldeneye, greater scaup, merganser, northern pintail, mallard, green-winged teal, and bufflehead.

Presently, the piping plover is the only animal which is locally considered endangered and which can be seen on a regular basis on PEI. Piping plover habitat consists of tidal flats and sand beaches. The present conditions of the shores along Webber Cove and Barbara Weit Estuary do not provide preferred habitat for the piping plover. This species has not been observed in the area in recent years.

The interface of wooded areas with meadows, marshes and agricultural land provides favourable diversified habitat for many small mammals. Red fox, raccoon, muskrat and other small mammals are likely found in the Webber Cove-Barbara Weit River watershed, but no specific data is available.

4.1.4 Agriculture and Industry

Land use in the Barbara Weit River and Webber Cove watersheds is similar in nature. The total area of 32.1 km² within the terrestrial bounds is primarily a rural area. Agricultural related activities account for the largest percentage of land use.

The original forest cover was removed during the eighteenth, nineteenth and early twentieth centuries. Deforestation has resulted in increased surface runoff. Receiving water bodies are subsequently subjected to siltation, and general degradation of water quality. The extensive use of agricultural pesticides and fertilizers has led to additional water quality deterioration.

Several communities and farming areas are located within the area (Sherbrooke, Travellers Rest, Lower New Annan, New Annan, Seabrook, Kelvin Grove, Mills Point, Clermont, Clermont Station, Kensington). The area has several small industries, that comprise only about 1% of the total area. Most of the area is classed as rural agricultural.

4.1.5 Recreation and Tourism

This area has an important recreation and tourism industry. In the area there are private cottages, rental units, and at least one trailer/tent campground. Some of these facilities advertise beaches suitable for swimming, and summer residents utilize beach front properties for such purposes. There are no public beaches or Provincial Parks in the study area.

No popular angling locations have been identified within the terrestrial study boundaries. Some eel fishing is carried out in the area. Ice fishing for smelt is the main recreational fishery, although some brook trout are taken in the Barbara Weit River above the Highway #2 bridge.

Malpeque Bay is part of an important goose migration route. As such, most of the large open fields around the bay, especially grain fields, are used by hunters for goose hunting.

4.2 Marine/Estuarine Environment

Malpeque Bay, which is encompassed by a series of lagoons and estuaries, is located on the northwest coast of Prince Edward Island. The Bay is shallow, its greatest depth being little more than 14 metres at the mouth of the Bay and less than 7 metres at the southern end. There are several inlets in the Bay with small inflowing streams. The waters typically have a salinity range of 24 - 26 ppt, except in the inlets where salinity is reduced by freshwater inflow. The effect of spring runoff on salinity is minimal due to the small drainage areas of the influent streams.

Malpeque Bay may be characterized as an estuary, as opposed to a marine or freshwater body. Malpeque Bay may be further classified as a bar built estuary, which are typically shallow basins into which the seawater penetration is restricted by a series of islands or bars which are broken by inlets.

The Barbara Weit Estuary is a smaller reflection of a bar-built estuary with inflow of water from Webber Cove restricted by a sand spit at the mouth of the estuary. The Indian River Estuary is similar in classification, structure, and size to the Barbara Weit Estuary.

4.2.1 Aquatic Vegetation

The vegetation in Webber Cove was dominated by three species: sea lettuce being the dominant species, followed by eel grass and hollow green weed. The vegetation is relatively dense and occurs in a narrow area in shallow waters. Vegetation becomes sparse toward the middle of Webber Cove. In the Barbara Weit Estuary, only unattached sea lettuce, which was discoloured and mostly decomposed, was found in subtidal waters.

4.2.2 Benthic Invertebrate Communities

Benthic invertebrates are sensitive indicators of the health of an aquatic system. An unstressed system will support many different types of invertebrates while environmental stresses may cause the number of different types of invertebrates in a system to decrease. Some species, however, may benefit from an increased supply of nutrients and the total numbers of individuals of a species may actually increase.

Both the Barbara Weit Estuary and the Indian River Estuary are naturally stressed systems due to abrupt changes in salinity caused by the ebb and flow of the tide, and the partial mixing that is characteristic of an estuarine system. In addition, low oxygen conditions have been observed in both systems in summer. The benthic invertebrate community in the area was found to reflect the extremes of water quality.

4.2.3 Fisheries Resources

Malpeque Bay is an important commercial fishing area. Commercially important species include cod, plaice, white hake, herring, eel, bar clam, soft-shell clam, mussels and lobster.

Lobster landings for the past 10 years range from 303 tonnes in 1985 to 499 tonnes in 1988. Since 1980, catches have been increasing. Mussel landings in the area have been found to fluctuate considerably in the past 5 years (e.g. 1.3 tonnes in 1985; 63 in 1986; 0.2 in 1987; 0.4 in 1988; and 29 in 1989). After a progressive increase from 1980 to 1985, soft-shell clam landings have decreased drastically, to only 1.1 tonnes in 1989 compared to 56 tonnes in 1988 and 58 tonnes in 1987. Oyster landings were good in 1980 - 1981, but decreased considerably from 1982 to 1986. The reason for the decline in oyster landings is unknown; however, it is likely that the landings reflect the natural fluctuation in abundance during this period. While the landings for the oyster fishery increased in 1987, they remained low for the following years. Eel and smelt landings for the past 10 years have also been decreasing.

According to interviews with fishermen, only lobster, smelt, eels, mussels, oysters and clams are commercially fished in Webber Cove and Barbara Weit Estuary. Eels, clams and smelt are the only species known to be fished recreationally.

Shellfish harvesting is an important activity in southern Malpeque Bay. Several privately-owned shellfish leases are located in the study area. The shellfish leases are divided as follows: 3 mussel leases; 11 shellfish leases; 1 oyster application; 1 oyster/quahog application; and 1 finfish lease.

The study area is currently subjected to two types of bacterial contamination closures: permanent closures and conditionally approved closures. The permanently closed area in southern Malpeque Bay is limited to the Barbara Weit River and Estuary, upstream of a straight line drawn across the mouth of the River. The conditionally approved closure area includes Webber Cove, as well as the Indian River Estuary and most of Chichester Cove.

4.2.4 Existing Sea Water Quality

Water quality information for the study area has been obtained from unpublished PEI DOE data, as well as from samples obtained through a WGA field program conducted in the summer of 1990. Following are summaries of important trends in this data.

4.2.4.1 Dissolved Oxygen

Dissolved Oxygen (DO) is an excellent indicator of conditions in a water body. Oxygen is produced during photosynthesis and is taken up during respiration. Dissolved oxygen levels in the Barbara Weit Estuary (suggested by the PEI DOE 1988 and 1989 data, as well as those found during the 1990 WGA studies) indicate a range of 1.1 to 13.8 mg/L. Sites in the Barbara Weit Estuary had the greatest range recorded while the narrowest range in DO was reported in Webber Cove. The extreme range may be characteristic of eutrophic

conditions, in which nutrient enrichment of the Estuary leads to supersaturation of the water with oxygen from photosynthesis. Then, as respiration and die-off increase, oxygen depletion occurs, resulting in low DO levels. The data suggest that this phenomenon may be particularly evident during the summer months.

4.2.4.2 Inorganic Nutrients

The major inorganic plant nutrients are forms of phosphorous and nitrogen. Phosphorous is generally readily available from seawater while nitrogen is normally supplied from freshwater systems. In areas of intensive agriculture both phosphorous and nitrogen may be contributed to water bodies from land runoff.

Growth of aquatic plants in freshwater is normally controlled by concentrations of phosphorous while in estuarine and marine systems concentrations of nitrogen generally control plant growth. In the Barbara Weit Estuary both nutrients are available in excessive concentrations.

It has been reported that phosphate enrichment of the Bideford River in Malpeque Bay results from commercial fertilizers applied to cultivated fields within its drainage area. It is assumed that the major source of nutrients in Barbara Weit Estuary other than the WWTP is from cultivated fields since farming is the major land use in the study area.

One form of nitrogen, un-ionised ammonia (ammonium), is potentially toxic to fish and shellfish . The proportion of un-ionised and ionised ammonia in marine waters may be calculated, given the pH and temperature of the waters. Given a maximum total ammonia concentration of 400 mg/L (1989 maximum recorded value), the concentration of un-ionised ammonia (mg/L) at a station just downstream of the waste water treatment plant would be at least 1.7 ng/L. This value is much greater than the level of un-ionised ammonia

reported to be potentially harmful to marine life (0.4 mg/L). As with other water quality parameters, ammonia concentrations were seen to decrease down the Estuary, and to be higher at low tide than high tide.

4.2.4.3 Coliforms

Coliform concentrations in natural waters have been used as an indicator of potential pathogen contamination since the last century. Routine bacteriological water quality surveys of shellfish growing areas in the Maritimes are currently carried out by Environment Canada. The objective of these surveys is to determine if the water quality is acceptable for the harvesting of shellfish. Fecal coliforms have been measured in Barbara Weit Estuary for several years by Environment Canada. Historical data for the years 1986 to 1988 exhibit considerable variation in coliform counts in Barbara Weit Estuary.

One of the problems affecting shellfish growing areas is agricultural runoff during wet weather. The 1990 data from PEI Department of the Environment for fecal coliforms counts were above the recommended value for shellfish harvesting at stations in the Barbara Weit Estuary. In 1990, fecal coliform counts were highest at a station near the WWTP outfall, exceeding 2000 MPN/100 mL.

Fecal contamination is often intermittent and may not be revealed by the bacteriological examination of a single water sample. For example, E. coli densities obtained during our field survey of May 31 are high compared to those obtained from the Environment Canada report of 1989 for the same date (i.e, 160 versus 11). Environment Canada recommends that the Barbara Weit Estuary remain permanently closed due to the fecal coliform counts recorded and the potential contamination of the Estuary due to industrial effluent. E. coli counts in Indian River are all within the recommended limits for harvesting shellfish.

4.2.4.4 Heavy Metals

During May, 1990, mussels were collected to determine heavy metal contamination in the study area. Mussels living in water contaminated with heavy metals naturally assimilate the metals into their tissues. Mussels taken during the survey were analyzed for cadmium, copper, mercury, lead and zinc content. No heavy metal analyses were performed for Indian River due to the fact that no live mussels were found in that area.

There are no criteria for acceptable levels of heavy metals in mussels. However, the Department of Fisheries and Oceans uses a general value of 0.5 ppm for cadmium. Our results were below this value for all sites. Values for other heavy metals were found to be normal background values.

4.3 Freshwater Environment

The discussion of the freshwater environment includes a description of water quality in the Barbara Weit River and Indian River. A freshwater sampling program was conducted by WGA on June 1, 1990 to document existing water quality in Barbara Weit River and Indian River, and to compliment data collected by the PEI DOE.

4.3.1 Barbara Weit River

The only freshwater station from the PEI Department of the Environment data is located where Highway 2 crosses the Barbara Weit River. The results for dissolved oxygen at this station ranged from approximately 10 mg/L to 13 mg/L. Total phosphorous values were in the range 0.09 - 0.11 mg/L. Total phosphorous concentrations were typically higher in winter than in summer. Higher concentration of phosphorous occur generally during winter when plant populations are minimal. The high concentration could also be due to land runoff following a period of mild weather. Nitrate concentrations were also constant at 4

to 5 mg/L. Ammonia was only measured in 1990; levels were constant throughout the sampling period at 0.1 to 0.3 mg/L. Fecal coliforms were available only for 1990. Results showed that fecal coliform concentrations often exceed the recommended value of 14 MPN/100 mL. The values ranged from 3 up to approximately 100 MPN/100 mL.

In the WGA survey, three sampling sites were located on the main stem of the Barbara Weit River below Highway No. 2. In addition, one site was located on a tributary north of Highway No.2, and one on a Cavendish Farms site drainage collection ditch.

The samples suggested that the Barbara Weit River has moderately hard (94 - 100 mg/L $CaCO_3$) and slightly alkaline (pH 7.29 - 7.42) water. Most water quality parameters were in compliance with guidelines for the protection of freshwater aquatic life.

Measurements of DO (11.4 - 12.9 mg/L) and BOD (0.9 - 3.1 mg/L) indicate that according to these criteria the Barbara Weit River is not a stressed system. DO concentrations less than 4 mg/L produce deleterious affects in aquatic organisms. The freshwater concentrations are well above this level. No specific guidelines are available for BOD, but waters with BOD levels less than 4 mg/L are deemed relatively clean. BOD only exceeded 4 mg/L in a drainage ditch from the plant site, and was below 4 mg/L in all natural waterways sampled.

Selected nutrient parameters were measured to determine the trophic status of the river. The enrichment of surface waters with nitrogenous materials and phosphates can result in water quality degradation and conditions unsuitable for the protection of freshwater aquatic life. Concentrations of the various forms of nitrogen were in compliance with all applicable guideline values. The determination of phosphorous levels is of relatively greater importance because it is the nutrient which most often limits freshwater production. Water

quality guidelines are not available for phosphate, but it has been recommended that total phosphorous concentrations not exceed 0.1 mg/L in flowing water. This guideline value was exceeded in three of the five samples.

Considering the major land use in the Barbara Weit drainage area is agricultural, it appears that agricultural drainage may be influencing the amount of total phosphorous and nitrate concentration in the surface water.

The results from heavy metal analysis indicate that most samples had concentrations below the detection level of the analytical method used. Where measurable concentrations occurred, guideline values were slightly exceeded for aluminum at 2 stations below Highway 2 (guideline value = 0.1 mg/L; measured range = 0.08 to 0.19 mg/L) and copper at 4 stations (guideline values = 0.002 mg/L; measured range = .01 to .02 mg/L).

Water samples were also analyzed for bacterial contamination. Three samples had fecal coliform concentrations which exceeded the recommended value (i.e. median concentration should not exceed 14 MPN/100 mL) for water used for shellfish production. These high values may have been a result of increased run-off from a recent heavy rainfall.

Based on the results of this sampling program, the water quality of the Barbara Weit River appears to be generally good. The main stem of the river appears to be receiving only minor influents for all parameters. The analysis of water in the site collection ditch revealed higher than acceptable levels of phosphorous, nitrite, ammonia, copper, and iron. However, such exceedances were not evident downstream of this site, suggesting rapid dilution of site runoff by the Barbara Weit River.

4.3.2 Indian River

Two sampling sites were located on Indian River, one above and one below Highway 20. In most respects, the water quality of the Indian River is very similar to that of the Barbara Weit River. It is also moderately hard (96 - 102 mg/L $CaCO_3$) and slightly alkaline (pH 7.49 - 7.56).

Levels of DO (12 - 12.2 mg/L) and BOD (2.3 - 3.1 mg/L) were approximately the same concentrations as in the Barbara Weit River. Nitrogenous compounds were also in similar concentrations to those recorded in the Barbara Weit River. The level of aluminum (0.09 - 0.1 mg/L) was found to be within guideline concentrations. All other heavy metals were measured at or below detection limits for the analytical method used. Coliforms (as E. coli) (19 - 72/100 mL) also exceeded the recommended value of 14 MPN/100 mL. The high concentration observed may be related to the excessive run-off following a period of heavy rain.

4.4 Existing Sources of Aquatic Pollution

Sources of contaminants discharging to the Barbara Weit River and Estuary can be classified into two categories. Point sources are sources of direct identifiable discharge into the system. The main point sources identified in this study are the effluent from the Northeast Energy Services Ltd. wastewater treatment plant and the Town of Kensington sewage treatment facility. Non-point sources are a result of surface runoff or groundwater discharge transporting nutrients and other contaminants from the land to the water. While the location and downstream area of impact for a point source may be easily identified, non-point sources may have a cumulative effect throughout the whole watershed.

4.4.1 Point Sources

Two point sources of aquatic pollution have been identified in the study area. These are reviewed in the following sections.

4.4.1.1 Northeast Energy Services Ltd.

The existing Cavendish Farms Wastewater treatment plant (WWTP) is presently operated by Northeast Energy Services Ltd. and is designed to treat the wastewater from the potato processing plant. The initial operation of the WWTP dates back to the 1960's. At that time, wastewater from the plant was treated by a primary vibrating screen and some holding ponds before it was released into the Barbara Weit Estuary. During the period from 1972 to 1979, the WWTP was modified. The modified treatment facility consisted of screening and primary clarification and an aerated lagoon system. This plant was operated until the spring of 1986, when a bulk volume fermenter (BVF) treatment system was installed.

The main function of the BVF and its associated treatment stages is to remove organic carbon, and reduce biochemical oxygen demand (BOD) and suspended solids in the final effluent. Waste water from the processing plant is digested in the BVF for eight days. Prior to discharge into the Barbara Weit Estuary, the effluent is polished in an aerated lagoon and then clarified.

Between January and July, 1990, the range of BOD concentrations was reported to be between 24 and 105 mg/L with an average of 46 mg/L. At this time BOD loadings ranged from 0.10 to 0.50 tonne/day with an average of 0.19 tonne/day. For the same period of time, suspended solids (SS) concentrations averaged 117 mg/L, resulting in an average loading of 0.54 tonne/day. Values for monthly average chemical oxygen demand (COD) are available only since January, 1989. Since then the COD has averaged 303 mg/L, corresponding to an average COD loading rate of 1.4 tonne/day. The long-term averages

for BOD, COD and SS loadings are 0.77, 1.4, and 0.96 tonne/day, respectively. Comparing the COD data to the BOD values for the final effluent, a ratio of BOD to COD of 0.25 is obtained.

Additional water quality parameters have been monitored by the PEI Department of the Environment and by NESL. The summary of 1990 data shows average nutrient concentrations of 131 mg/L of total N and 30 mg/L of total P, resulting in loading rates of 429 kg/day and 150 kg/day, respectively.

Coliform bacteria concentrations were also measured for the WWTP effluent. In coliform tests conducted in May, 1990, an average of 230,000 MPN/100 mL of fecal coliform and 438,000 MPN/100 mL of total coliform bacteria were observed.

Examination of long term trends in WWTP effluent data shows that while the flow rates have increased, both BOD concentration and BOD loading have decreased, especially after installation of the BVF in 1986. BOD concentrations in 1990 were observed to be 20 times lower than in 1986, while the corresponding BOD loadings are 15 times lower. Suspended solids (SS) concentration and SS loading show a reduction of 8 times and 6 times, respectively. Before 1986, effluent BOD and SS concentrations consistently increased as the flow rate increased, indicating that the previous lagoon treatment system was unable to handle the increasing flow.

Variations in coliform bacteria concentrations show a decreasing trend. From January, 1988 to May, 1990, coliform concentrations decreased from 650,000 MPN/100 mL to 230,000 MPN/100 mL.

The data sets available for nutrient levels in the effluent are incomplete. The 1990 data show that there is very little change in total-P and total-N in the effluent through the year. It was concluded that N and P concentrations have stayed at about the same levels since 1986.

Trends in the data suggest that BOD concentrations are higher during the winter and lower during the summer. The BVF system is a biological treatment process and the performance of the system is consequently temperature dependent. In addition to changes in external temperature influencing the treatment process, the Cavendish Farms potato processing plant also processes peas during the summer. It is not known at this time whether the change of influent composition or the change of temperature is the major cause of seasonal variation in the effluent quality. In 1989, however, the water quality difference between summer and winter was observed to be small. This implies that a more stable performance of the BVF system has been achieved.

4.4.1.2 Kensington Sewage Treatment Plant

The Kensington Sewage Treatment Plant (KSTP) discharge is located on the Barbara Weit River, upstream of the WWTP. It has been designed to treat the sanitary effluents from the Town of Kensington. The plant operated as a single cell stabilization pond from the early 1960's and was expanded to a two cell operation in 1976. The current plant consists of two facultative aerobic lagoons.

The KSTP handles the sewage flow from the Town of Kensington. The present population of the town is estimated to be 1200 to 1300. The KSTP effluent flow is reported to range from 250 m^3/day to 364 m^3/day.

The effluent from the KSTP is monitored for BOD and SS during the summer months. The BOD and SS loading rates are in the order of 9 kg/day. During a survey conducted on November 25-26, 1986, a fecal coliform concentration of 355 MPN/100 mL was observed in the KSTP effluent.

4.4.2 Non-Point Sources

Non-point sources can be classified as being of one of three main types: agricultural, residential and industrial. In the study area, agricultural runoff is assumed to be the greatest non-point source of pollution. The cumulative effect of contaminants entering aquatic systems from lands used primarily for agriculture can often be significantly higher and, even have a greater impact than a point source. In the Barbara Weit/Webber Cove watershed, approximately 69% of the land area is currently used for agriculture. Cultivated crops account for approximately 64% of the watershed land area, while 5% is used for livestock pastures. Runoff from cultivated areas may potentially carry with it various types of fertilizer, pesticides, silt and organic matter. Fertilizers discharged through runoff may release nitrates, phosphates and potassium to surface waters. The release of these nutrients encourages aquatic plant production and increases the rate of eutrophication. Similarly, manure spread on fields as a natural fertilizer may be discharged and result in fecal coliform contamination. Silt (transported topsoil) and organic matter (i.e. leaves, terrestrial plants) may detrimentally affect water quality by degrading habitat and increasing BOD.

Pesticides transported to aquatic systems may accumulate in bottom sediments, suspended particulate matter and in the fatty tissue of aquatic fauna. Cases of fish kills and aquatic insect kills have both been attributed to pesticides discharged into water bodies.

Residential/cleared land accounts for 6.5% of the current land use in the watershed. Residential runoff may contain fecal coliforms, pesticides and refuse. Aquatic habitat degradation, BOD increases, and damage to aquatic life may result from such sources.

While the major area industrial pollution sources are classed as point sources, non-point sources as a result of surface run off or groundwater seepage may discharge pollutants from industrial plant sites and roads. Oils, garbage, fertilizers and fecal coliform may be discharged from the various industrial and commercial sites in the watershed, resulting in further aquatic habitat degradation.

5.0 FINDINGS OF THE ENVIRONMENTAL STUDIES

This chapter presents findings of the studies conducted as part of the EIA. The findings are summarized under headings which correspond directly to the final reports prepared by WGA, and hence to the issues of concern identified by the PEI DOE.

5.1 Process Plant Expansion

Volume 1 of the final reports was prepared as an environmental review of the Cavendish Farms process plant expansion. The findings of this review are summarized in this section.

5.1.1 Additional Energy Requirement

Steam is required in the process plant to peel, condition, blanch, dry and fry potatoes. Additional steam is also required to heat buildings. The boiler plant produces steam by combustion of No.6 fuel oil.

Plant records indicate that the present steam production is approximately 27,216 kg/hr with a corresponding fuel consumption of 1997 kg/hr of fuel. With plant expansion, it is estimated that approximately 39,000 kg/hr of steam will be required, through a consumption of 2,860 kg/hr. The current Zurn and B & W boilers will be sufficient to supply these long term requirements.

Electricity is currently supplied from the provincial grid, and some instances, from the wastewater treatment facilities operated by Northeast Energy Services Ltd.(NESL). At capacity, the plant currently consumes approximately 2,800,000 kWh/month. The NESL plant can export 100,000 kWh to the process plant, in a good month. However, during the

pea processing period the wastewater temperatures are normally lower and electrical generation is barely sufficient to supply the NES plant. Thus, no energy is exported during July and August.

Discussions with personnel at the Cavendish Farms plant indicate that the existing substation is sufficient to handle the future requirements of an expanded plant. However, it was noted that the existing capacitor bank will require upgrading in the future. It is uncertain what effect the final treatment plant modifications will have on electricity export capabilities to Cavendish Farms.

5.1.2 Boiler Plant Emissions

Operation of the expanded facility will result in increased boiler plant emissions. Sulphur dioxide, carbon monoxide, nitrogen dioxide and particulate matter are typical products of combustion that require monitoring in accordance with the PEI Guidelines. All available data for the existing plant operation show that the concentration of sulphur dioxide and carbon monoxide are below the maximum allowable one hour average ambient concentration limit. Data for nitrogen dioxide and particulate matter are not available at this time. However, concentrations of nitrogen and particulates will be controlled within allowable limits.

5.1.3 Process Plant Emissions

Process plant air emissions consist of water vapour, volatiles and fats. No additional sources of emissions are anticipated from the expanded plant, although additional capacity will increase the mass rate of release of some process plant air emissions into the ambient air.

5.1.4 Odorous Emissions

Odour from the wastewater treatment plant will be addressed by NESL and in the design of the future treatment plant. A scheduled clean-up of the abandoned settling ponds will eliminate odour problems in the ponds. Other odours associated with potato processing include odours from the peeler exhaust, blancher exhausts, dryer exhausts, building exhausts, fryer stack and ambient pre-cook. While peeler exhaust odour will experience an increase proportionate to the production increase, blancher exhaust, dryer exhaust and fryer exhaust odours will experience a less than proportionate increase. Building exhaust and ambient pre-cook odours will both experience a minor increase.

5.1.5 Noise Emissions

Noise emissions have not been a concern for the plant to date. Additional noise generated at the plant due to the expansion will be from a new oil defatter, with blower units, and from increased truck traffic. Neither of these sources is expected to result in a significant increase in noise emissions at the site. Current plant noise levels, both background and peak levels, will be measured at the property line and at the closest dwelling to the plant. This will supply data for future comparison.

5.1.6 Wastewater Treatment Considerations

Potato Processing Plant Liquid Effluent Regulations and Guidelines are set by the Federal Fisheries Act in order to control liquid effluents from potato processing plants. Maximum authorized average daily deposits under the Regulations for potato product plants are:

Biochemical Oxygen Demanding Matter	-	0.9 kg/tonne of raw potato
Total Suspended Matter	-	0.8 kg/tonne of raw potato

The regulations apply to new plants and expanded plant operations.

The existing wastewater treatment plant (WWTP) presently operated by Northeast Energy Services Ltd. meets the Potato Processing Plant Liquid Effluent Guidelines for the existing Cavendish Farms operations. However, some performance problems such as hydrogen sulphide (H_2S) odours and, aeration problem of the activated sludge, have been identified.

Since nitrogen (the main nutrient possibly contributing to eutrophication in the estuary) and coliforms has been identified as of concerns, nitrogen removal and a better bacteria control has been recommended for the new WWTP. Cavendish Farms has also addressed the problem of fat in the wastewater by installing fat/solids/water separation and collection systems in the plant.

In the design of the expanded wastewater treatment plant, a disinfection unit will be added to reduce coliform levels, and a sludge dewatering system to handle sludge disposal effectively will be used. Additional aeration and clarification systems and system options to handle nitrogen removal are being investigated.

5.1.7 Hazardous Substances

The current inventory of hazardous substances at the plant is not expected to increase or change substantially after the expansion. Emergency response plans have been developed to handle accidental spills and are currently under review. Containment and disposal plans have been established to ensure all regulatory requirements will be met and all impacts minimized. Environmental and occupational safety is monitored and maintained on a continuous basis.

5.1.8 Petroleum Storage Tanks

There are no additional petroleum storage tanks associated with the proposed expansion. However, the existing tankage will be upgraded by installing a containment system around the storage tanks in accordance with the Petroleum Storage Regulations for the Province of Prince Edward Island.

5.1.9 Plant Area Runoff

Existing discharges to the Barbara Weit River include the drainage ditch and non-point runoff from adjacent areas. The average discharge of the drainage ditch has been calculated to be approximately 400 L/min or 97 percent of the runoff entering the Barbara Weit River from the total plant area.

Results of the water quality program undertaken in June, 1990 show several of the parameters had concentrations that would be of concern if the water was discharged directly to the river, rather than to the adjacent swamp area. Water samples collected downstream of the swamp area show that site drainage has a slight influence on water quality in the river. However, for most parameters the difference in concentration between the site upstream and downstream of the swamp area is negligible. The swamp seems to act as an efficient treatment system, greatly reducing the concentration of potentially problematic parameters before the site drainage reaches the river.

5.1.10 Residual Environmental Concerns

A study commissioned by Cavendish Farms concluded that the supernatant in the existing lagoons north of the railway tracks should be directed, after appropriate pre-conditioning, to the NES treatment plant and that the sludge in Lagoons 1,2,3,4, and 5 be allowed to dry prior to backfilling the ponds.

It was also recommended that the sludge in Lagoon 6 should be excavated and spread on agricultural land. However, subsequent examination of the sludge in Lagoon 6 revealed that it consists of potato peels. It was recommended that the sludge therefore be removed and disposed of at a landfill site.

Due to land ownership restrictions, the NESL treatment plant expansion will be to the east and will require the excavation of the adjacent lagoon. Excavated material will be disposed of in an engineered landfill on the Cavendish Farms property north of the railway tracks. The landfill will be lined with a synthetic liner and will include a leachate collection system. Suitable soils from surrounding operations will be used as cover to reduce odours from the landfill. Although the design of the landfill has not been finalized, Cavendish Farms has recommended that it be sized to allow for disposal of sludge from the existing lagoons.

5.1.11 Other Waste Management Considerations

Potato waste is currently used as cattle feed by a private contractor. It is estimated that 19,200 tonnes of potato waste per year are produced and that 27,000 tonnes will be generated per year after the expansion.

Waste fat is collected in holding tanks and sold to rendering plants in Atlantic Canada. It is expected due to improvements in fat recovery and conservation that total fat waste will not exceed the present level of 135 tonnes per day.

The generation of silt and stones will increase proportional to the additional raw potato requirements after the expansion. It is estimated that 1475 tonnes (40% increase) each of silt and stones will be generated from the receiving warehouse. Stones and mud from Island Holdings Ltd. is expected to increase 40 percent to 1570 tonnes per year in long-term. The abandoned lagoons located north of the CN rail tracks are currently considered for the future disposal of stones and mud. Uncontaminated silt is presently being returned to the fields.

The expanded plant is expected to generate additional quantities of plant refuse. Cavendish Farms recycles all cardboard products and additional disposal requirements will be estimated following Superior Sanitation Ltd. evaluation on the waste quantities generated.

Treatment plant sludge has recently been used with success as a fertilizer on surrounding fields. Data indicate this method of disposal is a suitable option. Northeast Energy Services Ltd. is currently investigating dewatering options, handling practices and alternate disposal methods.

5.2 Groundwater Evaluation

There are currently six production wells which provide the freshwater requirements to Cavendish Farms; an additional well has recently been constructed. It is estimated that the

proposed expansion of the facility will require 7.57 x 10^6 L/day (for 250 day/year), at each flow and 5.68 x 10^6 L/day at average flow. The current installed capacity of the Cavendish Farms production wells is 6.98 x 10^6 L/day.

Groundwater modelling was undertaken to provide characterization of the groundwater regime in the study area under three different recharge and pumping conditions. A steady state, two-dimensional model for a confined aquifer with recharge was chosen. The model provided an approximation of the groundwater regime and indicates that for the three scenarios the drawdown created by pumping would result in varied gradients from the river. It was determined that baseflow will be sufficient to recharge the wells at the daily pumping rate of 5.68 x 10^6 L/day. Based on the analysis of the available information, no long term, continual lowering of the water table in the Barbara Weit Watershed is expected. The evaluation also indicates that pumping on one side of the river will not significantly influence the groundwater levels on the opposite side of the river.

The implications of baseflow reduction on other surface water resource uses were also assessed. No impact on aquaculture, recreational fishery, recreation, agriculture, and aquatic habitat in general are anticipated since maximum drawdown that can be expected will not exceed the seasonal fluctuation of the water level in the stream.

The annual hydrologic mass balance of the Barbara Weit River Basin was also determined. The results indicate that no significant impacts on the watershed are expected from the current and proposed pumping in the Cavendish Farms wellfield. The baseflow reduction on an annual basis during low precipitation and peak flow pumping is less than 43% and the streamflow reduction is less than 29%. The effects of groundwater withdrawals correlated well with mass balance calculations.

Although some over-pumping could occur during the winter months at peak flow rates of 7.57×10^6 L/day, it is on a short term basis (based on the analyses conducted, the temporary overpumping will not create an overall storage depletion in the aquifer). Groundwater modelling and other calculations indicate that no additional wells will be required.

Factors that may effect the quality of groundwater within the total recharge area of the production wells include: use of agricultural pesticides, herbicides, and fertilizers residential and industrial sewage disposal and wastewater disposal, above ground storage of fuel and sewage disposal systems, gasoline storage, industries, etc. Due to several instances of groundwater contamination within the recharge area, a wellfield protection plan is recommended of 500 metres to protect the quality of the groundwater within the Cavendish Farm wellfield.

5.3 Site Selection For Effluent Outfall Location

The preferred outfall(s) was chosen from four alternatives outfall locations, based on the likelihood of risks to valued ecosystem components (VEC's) at each site as a result of construction and operation. The outfall(s) found to have the least possible environmental impacts was selected for more detailed assessment (see section 5.4).

The four potential outfall locations considered were:

1) Relocating the existing outfall in Barbara Weit Estuary;
2) Locating an outfall in Webber Cove, southern Malpeque Bay;
3) Locating an outfall in Gordon Cove, Northumberland Strait; and,
4) Locating an outfall off Park Corner, Gulf of Saint Lawrence.

The outfall options in Gordon Cove and off Park Corner present the greatest number of potential risks to the environment. If discharges similar to those from the existing wastewater treatment plant were made to these locations, the effluent's un-ionised ammonia concentration at the point of discharge would be toxic to fish and shellfish in both cases. There are also concerns related to potential spills or leaks of piped effluent into wetland, freshwater or groundwater systems. Construction and operation of either of these alternatives would place previously unaffected resources at potential risk of deleterious impacts.

The improved effluent treatment levels proposed for the remaining two outfallS, in Webber Cove and Barbara Weit Estuary, would result in improved water quality in the Barbara Weit Estuary with either outfall. Acceptance of one of these alternatives over the other would confine the bounds of potential impact and minimize the number and size of VEC's at risk. Further study is recommended to determine the relative advantages and disadvantages of the preferred alternatives. This is discussed in the following sections.

5.4 The Assimilative Capacity of the Barbara Weit Estuary

This section presents a discussion of the results of a modelling exercise conducted as a means to describe the assimilative capacity of the Barbara Weit Estuary and Webber Cove.

Hydrodynamic and transport modelling was undertaken as a means to describe the assimilative capacity of the Barbara Weit Estuary and Webber Cove, and the dilution and distribution characteristics of effluent from the existing and a proposed WWTP.

5.4.1 Water Quality Parameters of Concern

Several water quality parameters related to the release of effluent from combined point and no-point sources have been identified to be of concern in relation to the receiving waters. These include biochemical oxygen demand (BOD), dissolved oxygen deficit (DOD), nutrient loadings, coliforms, and suspended solids.

5.4.2 Modelling Pathway and Rationale

The goal of the modelling exercise, as stated earlier, was to describe the assimilative capacity of the Barbara Weit Estuary and Webber Cove and the dilution and distribution of effluent from the existing and a proposed WWTP.

The first step in the exercise was to initialize the model to best simulate the natural conditions, and to some degree define a worst case scenario. The model was initialized using data obtained from published sources, PEI DOE sampling programs and the WGA field visits in June and August, 1990, and the previous experience of the modellers. For some aspects of the initialization a choice of conditions were available, i.e. tides, winds, and boundary reflections. To determine which combinations of these conditions resulted in minimal dilution and distribution of effluent (worst case scenario) a series of sensitivity analyses was conducted.

Upon completion of the sensitivity analyses, the water quality modelling was undertaken. The worst case scenario conditions were applied. A total of 10 water quality simulations were completed. Eight of these simulations investigated the conditions of normal and upset

discharges from the existing waste water treatment plant into the Barbara Weit Estuary. The final two simulations investigated normal discharges from a proposed expanded waste water treatment plant into the Barbara Weit Estuary and into Webber Cove.

5.4.3 Outfall Locations

Two effluent outfall locations were evaluated in the modelling exercise, one in the Barbara Weit Estuary and the other in Webber Cove. Comparison of model results would provide a basis for deciding upon the location of the waste water treatment plant outfall.

The present effluent outfall is located in the Barbara Weit Estuary and at low tide flows across the tidal flats as a surface discharge. For modelling purposes, the location of this outfall was slightly relocated about 600 metres downstream. The outfall would there be submerged at all times. By placing the outfall in this location it was thought the aesthetic and other problems associated with the effluent flowing over the exposed intertidal zone at low tide could be avoided. In further discussions of effluent discharge to the Barbara Weit Estuary, this new location is implied.

A second outfall location was chosen in Webber Cove. This location was chosen to test the hypothesis that effluent discharged into Webber Cove might be better assimilated and/or diluted than in the Estuary. The proposed Webber Cove outfall was located in approximately 4 metres of water at low tide. It is thus a submerged outfall.

5.4.4 Characteristics of Effluent Discharges

The following sections give characteristics of the existing WWTP discharges and the proposed expanded WWTP discharges. These effluent discharges were applied to the water quality model.

5.4.4.1 The Existing Waste Water Treatment Plant

Effluent discharges from the existing waste water treatment plant were modelled in an attempt to determine the characteristics which most impact the Barbara Weit Estuary and Webber Cove. Normal discharges from the existing waste water treatment plant were characterized as follows:

Flow rate	0.066 m^3/s
Temperature	28 °C
Salinity	0 ppt
BOD	125 mg/L
DOD	8 mg/L
Total Nitrogen	130 mg/L
Total Phosphorous	30 mg/L
Fecal Coliforms	230,000 MPN/100 ml
Suspended Solids	140 mg/L.

These effluent characteristics represent loadings that the existing waste water treatment plant may discharge to the Estuary.

Also considered were effluent characteristics that could occur during an upset discharge from the existing waste water treatment plant. Four separate upset conditions were investigated. First, a slug BOD discharge of 1200 mg/L for 12 hrs was modelled. Second,

this slug was combined with a total nitrogen discharge of 500 mg/L. Third, an upset of BOD at 1200 mg/L for 12 hours was modelled with the addition of no reaeration capability in the water. Finally, a BOD upset discharge of 1200 mg/L lasting for 96 hours.

The results of the model runs of normal and upset discharges from the existing waste water treatment plant into the Barbara Weit Estuary were compared among each other, with actual field data and observations, and with the results of model runs simulating discharges from a proposed expanded waste water treatment plant.

5.4.4.2 Proposed Expanded Waste Water Treatment Plant

Based on the results of the modelling exercises involving the existing waste water treatment plant, a set of characteristics that an expanded facility must conform to was established. These are given as follows:

Flow rate	0.088 m^3/s
Temperature	28 °C
Salinity	0 ppt
BOD	60 mg/L
DOD	8 mg/L
Total Nitrogen	50 mg/L
Total Phosphorous	10 mg/L
Fecal Coliforms	2,000 MPN/100 ml
Suspended Solids	45 mg/L.

The discharge of an effluent having these characteristics was modelled for both the Webber Cove and Barbara Weit Estuary outfall locations. The results of this modelling were compared to the results of modelling of the existing situation.

5.4.5 Discussion of Results of Water Quality Modelling

This section provides a discussion of the water quality modelling results in relation to each other, and actual field data and observations. The conclusions given here provide a summary of impacts related to discharges from the existing waste water treatment plant, in comparison to predicted impacts resulting from discharges from the proposed expanded waste water treatment plant to either the Barbara Weit Estuary or Webber Cove. Impacts will be discussed under the categories of toxicity, oxygen demands, primary production, bacterial inputs, and suspended sediments. Finally, a recommendation will be made concerning locating the outfall from the proposed expanded WWTP.

5.4.5.1 Toxicity

Discharges from the existing Cavendish Farms WWTP are potentially toxic primarily with respect to one parameter: ammonia. Under worst case conditions of no nitrification or algal uptake, normal discharges from the existing WWTP could cause levels of unionised ammonia to approach toxic values throughout the Estuary, even though the nitrogen discharged is well diluted and dispersed. Modelling of upset discharges of nitrogen showed increases in levels throughout the Estuary, and also extending into Webber Cove. There may however, be some nitrification or uptake of ammonia that may reduce the toxic effect. Data collected by PEI DOE show that on some occasions potentially toxic ammonia levels occur as far down as the mouth of the Estuary.

The observed and modelled conditions of ammonia toxicity have potential for impact on commercial fisheries within the study area. Model results and field data show that toxic conditions can occur. This may cause an avoidance reaction by biota capable of moving to other areas, or death to those more sessile organisms. Therefore, for fisheries in the Barbara Weit Estuary and Webber Cover to improve, this constraint must be eliminated.

The proposed expanded WWTP is designed to discharge all nitrogenous wastes in the form of nitrate. Therefore, no toxic affects of ammonia will occur as a result of normal discharges from this facility, regardless of where the outfall is located. The positive affect on fisheries resources would be significant, especially in the Estuary.

Should the nitrification system of the proposed expanded WWTP fail, and the outfall remains in the Estuary, the toxic effect on the Estuary would be greatly improved over current toxicity conditions. If the nitrogen discharges in each case were in the form of ammonia, this would represent a reduction in areas affected of about 50%. Note this is comparing normal operation of the existing WWTP with an upset discharge from the proposed WWTP.

Comparisons suggest that there would also be a limited toxic effect of ammonia in either the Estuary or the Cove should the nitrification system of the proposed expanded waste water treatment plant fail and discharge is made directly to Webber Cove. This effect would probably be localised around the outfall location.

5.4.5.2 Oxygen Demands

Modelling of the situation with normal discharge from the existing WWTP suggested that combined oxygen demands on the Barbara Weit Estuary could be as high as 4.7 mg/L. These demands included those induced by biological oxygen demand (BOD) and dissolved oxygen deficit (DOD) discharge (0.7 mg/L), nitrification of ammonia (2.5 mg/L), and decay of induced algal production (1.5 mg/L). Even excluding the algal related oxygen demand, the total could be as high as 3.2 mg/L.

The spatial extent of this oxygen demand is difficult to predict. Whether nitrification of ammonia would occur within the Estuary or not is questionable (if the nitrogen discharged was in the form of ammonia). The PEI DOE and WGA field data suggests that most of

the nitrification would occur within the Estuary. If algal production was induced by the effluent, it could occur in either the Estuary or Cove, depending on uptake rates. From these observations it could be concluded that under normal discharge conditions from the existing WWTP, the spatial extent of induced oxygen demands would be confined to the Estuary.

The oxygen demands discussed above would cause anoxic conditions to develop in the Estuary only if the dissolved oxygen content of the water were reduced by some other factor. This other factor could be the respiratory activity of algae and vascular plants during the night or very dark days, or warm temperatures and high salinities reducing the oxygen carrying capacity of the water. Field data collected by Washburn & Gillis & Associates Ltd., and PEI DOE show occasional very low dissolved oxygen levels in the Estuary. Also, reports of foul odours coming from the Estuary over recent years clearly indicate that anoxic conditions develop there.

Modelling of upset discharges from the existing WWTP indicate that such discharges are the more probable causes of anoxic conditions in the Estuary. These results showed that the DOD resulting from BOD alone could be as high as 3.4 mg/L. When combined with ammonia demands, increased algal demands, and low ambient oxygen levels, this DOD could have significant impacts. This observation of upset influence on oxygen demand is supported by local observations that general water quality in the Estuary seems to have been improved since the existing level of treatment (fermenter) was installed at the existing plant.

The proposed expanded WWTP is designed to greatly reduce BOD, ammonia, and other nutrient discharges from the facility. In combination with systems to reduce the frequency of upset events, this new facility will greatly reduce the chances of anoxic conditions developing, as compared to the existing situation.

Modelling of the expanded waste water treatment plant discharge to the Estuary predicted a maximum effluent related total Estuary oxygen demand of only 1.2 mg/L, with only 50% of this attributed to BOD discharges. The spatial extent of this demand would be confined to only the upper reached of the Estuary, with no impacts to Webber Cove. The ambient dissolved oxygen levels in the Estuary would have to be very low as a result of other factors for normal discharges from the proposed expanded WWTP into the Estuary to result in anoxic conditions. Upset conditions would be similar to, but no worse than, present conditions.

The positive changes in oxygen demands to the Estuary represent an opportunity for recolonization at this area by biota presently excluded by existing conditions of anoxia. Improvements in fisheries resources and benthic communities in both Webber Cove and the Estuary would result.

5.4.5.3 Primary Production

It is not possible with the data available to determine exactly how nutrient discharges from the existing WWTP impact primary production levels in the Barbara Weit Estuary and Webber Cove. Nutrient levels measured by WGA, and PEI DOE are very high in both areas. The luxuriant nutrient levels suggest that primary production is limited by some other factor. If nutrients were the limiting factor, either nitrogen or phosphorous concentrations would be much lower than those observed. The best evaluation that can be made with the information available is to look at the dilution and dispersion of nitrogen and phosphorous predicted by the model.

Water quality modelling showed the spatial extent of nitrogen and phosphorous normally discharged by the existing WWTP. The effect of both of these nutrients could be seen to extend well into Webber Cove. Modelling of the discharge of nutrients from the proposed expanded WWTP into the Estuary resulted in a much reduced spatial impact. Levels in

both the Estuary and Cove were reduced by about 40% from the existing situation. Background levels were seen over more of an area of the Cove. If discharged nutrients are considered to contribute to primary production, the changes predicted by improved treatment suggest that with this situation, primary production due to WWTP discharges will be greatly reduced in magnitude and spatial extent.

Modelling of future discharge to Webber Cove predicted improvements in nitrogen and phosphorous levels in the Estuary and Cove over both existing discharge to Estuary and future discharge to Estuary. These results suggest that primary production induced by WWTP effluent discharge would be greatly reduced by this option. However, discharges to Webber Cove represent an unknown situation. It is possible that nutrients presently discharged to the Estuary are taken up by primary producers before they reach the Cove. This observation is supported by WGA and PEI DOE field data, which show reduced nutrient levels and chlorophyll-a levels at stations near the mouth of the Estuary from those further upstream. Therefore, if nutrients from the proposed expanded WWTP are discharged directly to the Cove, it may result in stimulation of primary production in this area. Admittedly, this increase may be only localised around the outfall locations, but long term trends of increasing production may result. There is also potential that increase in production of the demoic acid producing algae (Nitzschia pungens) may result. Larval lobster and bivalve production could be affected.

5.4.5.4 Bacterial Impacts

Modelling of coliform discharges from the existing WWTP into the Barbara Weit Estuary showed that such discharges could result in shellfish harvesting closures in all of the Estuary and about 50% of Webber Cove (see Figure 5-1). In addition, swimming areas would be closed over most of the Estuary. These model predictions correspond with actual shellfish closures in the area.

Modelling of the future situation predicted that discharges of coliforms from the proposed expanded WWTP to the Estuary would result in the entire Estuary and Cove area opened for swimming, all of the Cove open for shellfish harvesting, and about 50% of the Estuary open for shellfish harvesting (see Figure 5-2). These predictions represent a great increase in the shellfish fishery potential of the area, if the WWTP were the only source of coliform in the area. In fact, land wash may be responsible for much of the closure areas during high rainfall events.

Discharges of coliforms from the proposed expanded WWTP into Webber Cove would result in the entire Estuary and Cove open for swimming, as well as the entire Estuary and Cove open for shellfish harvesting. Note, however, that the levels seen around the outfall location for this model run were only marginally below the level for shellfish harvesting closure (see Figure 5-3). Slight increases in coliform discharge levels to this area would, therefore, result in a closure where none existed before. Furthermore, upset discharges of coliforms directly to this area would probably result in shellfish harvesting closures throughout all of Webber Cove and extending into other areas of southeast Malpeque Bay. This could result in a significant impact to the valued shellfish resources of the area.

5.4.5.5 Suspended Sediments

The impact of suspended sediments discharged from the existing WWTP to the Barbara Weit Estuary was modelled (Figure 5-4). Results showed a solids plume extending past the mouth of the Estuary into Webber cove. Settlement of these solids has, over many years, undoubtedly affected benthic invertebrate communities in the Estuary as far down as the mouth. Washburn Gillis Associates Ltd. field data indicated communities of low diversity and biomass in this area, suggesting a possible (but not conclusive) impact.

The proposed expanded WWTP is designed to minimize suspended solids discharges. Water quality modelling predicted that if discharged to the Estuary, effluent from this

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FIGURE 5-1
EXISTING DISCHARGE TO THE ESTUARY
Coliforms (MPN/100 ml)

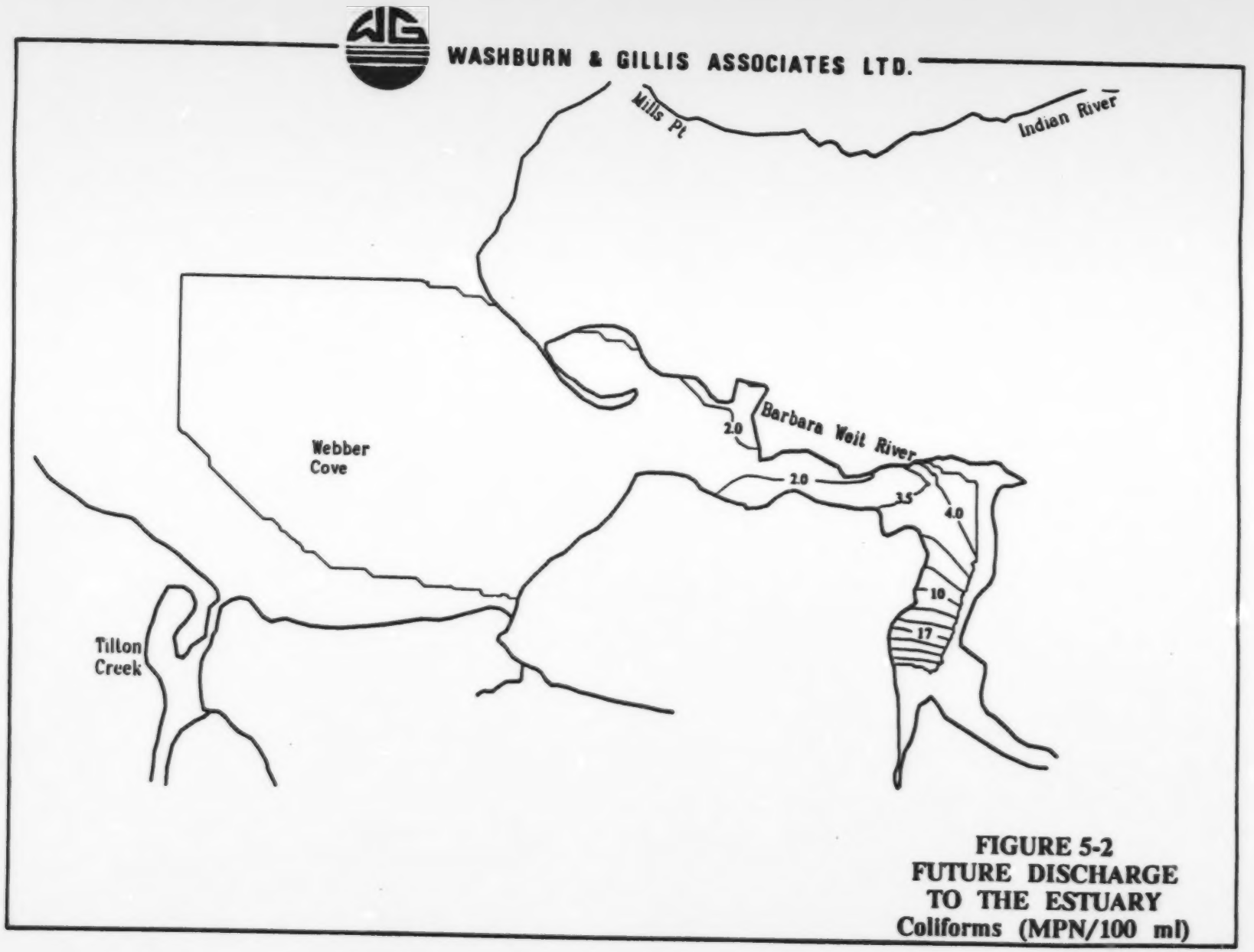

FIGURE 5-2
FUTURE DISCHARGE
TO THE ESTUARY
Coliforms (MPN/100 ml)

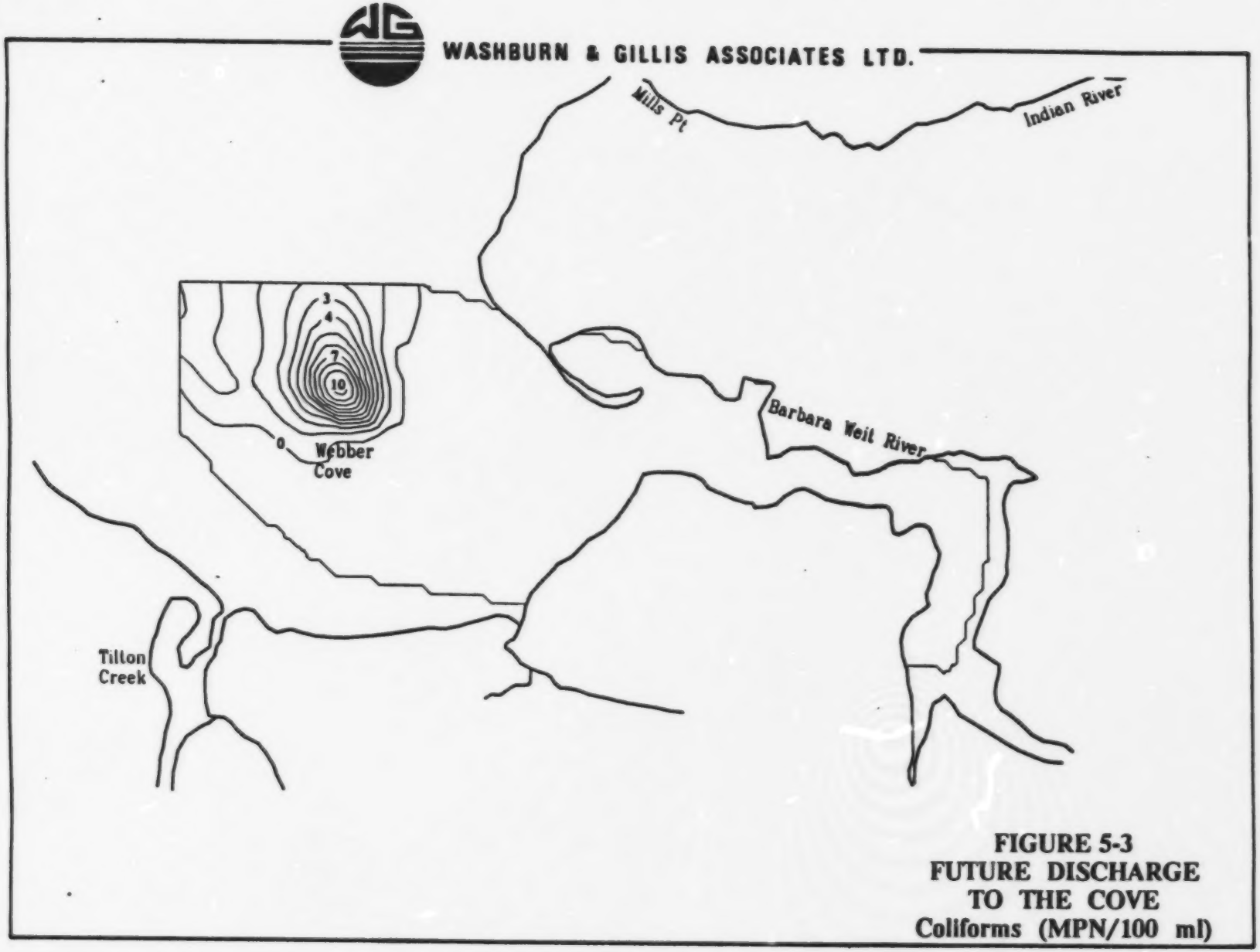

FIGURE 5-3
FUTURE DISCHARGE
TO THE COVE
Coliforms (MPN/100 ml)

facility would impact solids deposition only in the upper reaches of the Estuary, not to its mouth or into Webber Cove (see figure 5-5). This prediction suggests that under these conditions benthic invertebrate communities may increase in diversity and abundance in the Estuary. Changes such as this would positively affect all trophic levels of the Estuary.

Water quality modelling predicted the impact of solids discharged from the proposed expanded WWTP directly to Webber Cove (see figure 5-6). This model run suggested that no effluent related loadings would occur in the Estuary, but that a small area around the outfall in the Cove would be impacted. As with the present situation in the Estuary, this impact could result in long term changes to benthic invertebrate communities in this area. This negative change would also have a long term effect on production levels of other communities in the Cove.

5.4.6 Recommendations for Location of the Outfall

The results of the water quality modelling, and analyses of field data and observations provide no clear answer as to the best location of the outfall for the proposed expanded WWTP during normal operation. Location of the outfall in the Barbara Weit Estuary would result in improvements in dissolved oxygen levels, nutrient levels, coliform levels, suspended solids levels, and increases and improvements in available fisheries resources and benthic invertebrate communities. Location of the outfall in Webber Cove would also result in improvements in the above factors, many of which to a greater degree. However, location of the outfall in Webber Cove may result in a greater frequency of shellfish harvesting closures in the area, greater suspended solids disposition in the area, and possibly greater levels of primary production in the area. Also, impacts related to the Webber Cove

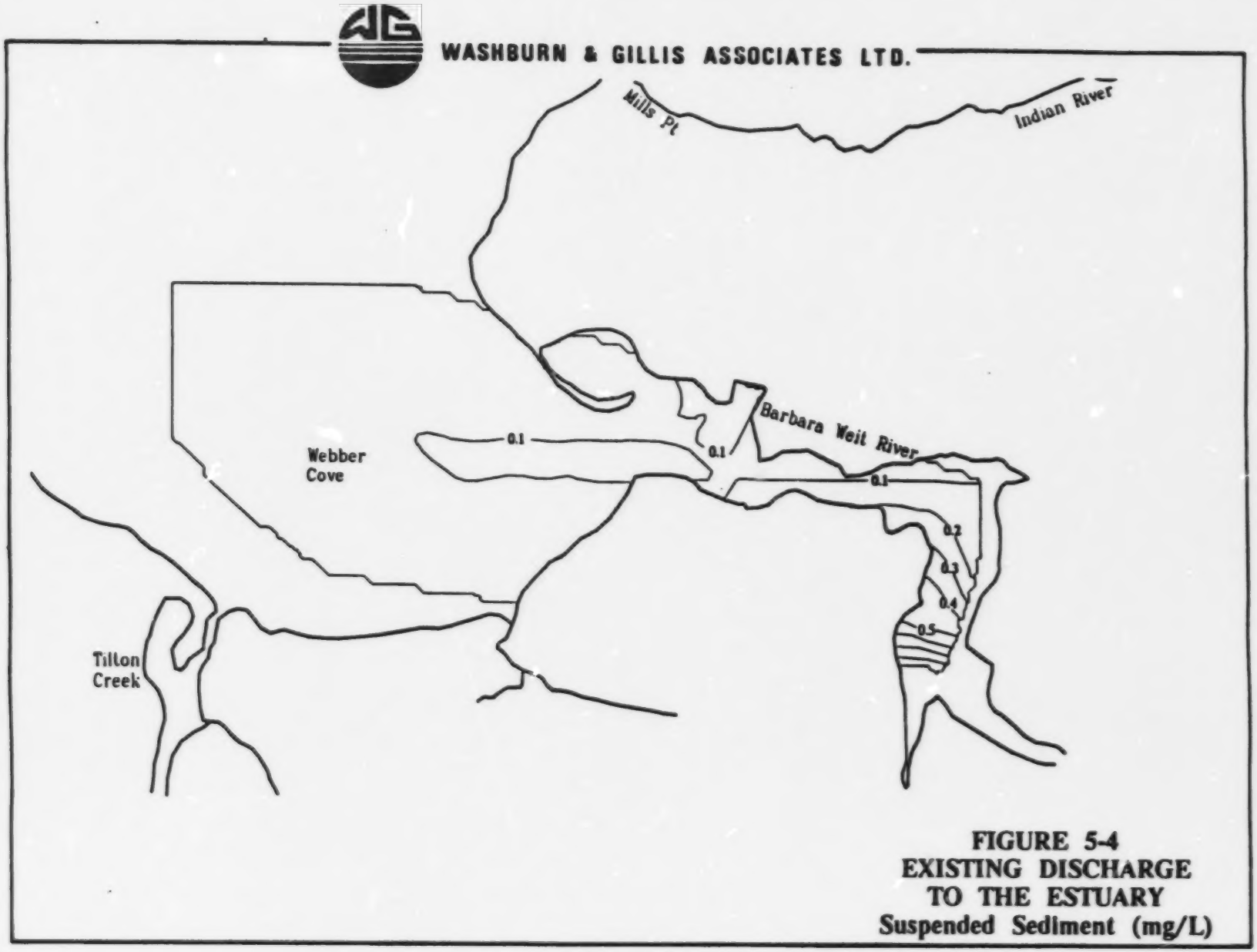

FIGURE 5-4
EXISTING DISCHARGE TO THE ESTUARY
Suspended Sediment (mg/L)

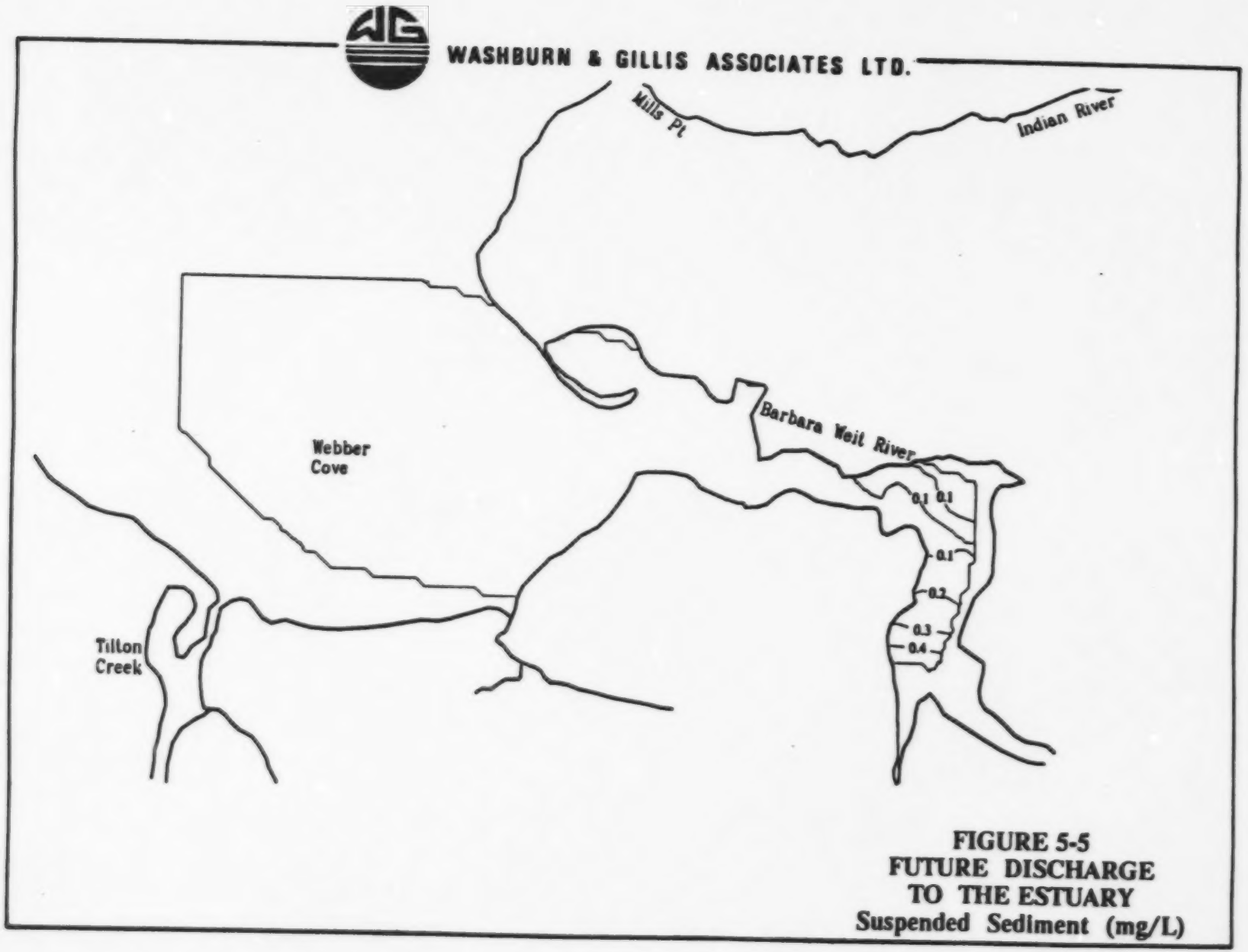

FIGURE 5-5
FUTURE DISCHARGE
TO THE ESTUARY
Suspended Sediment (mg/L)

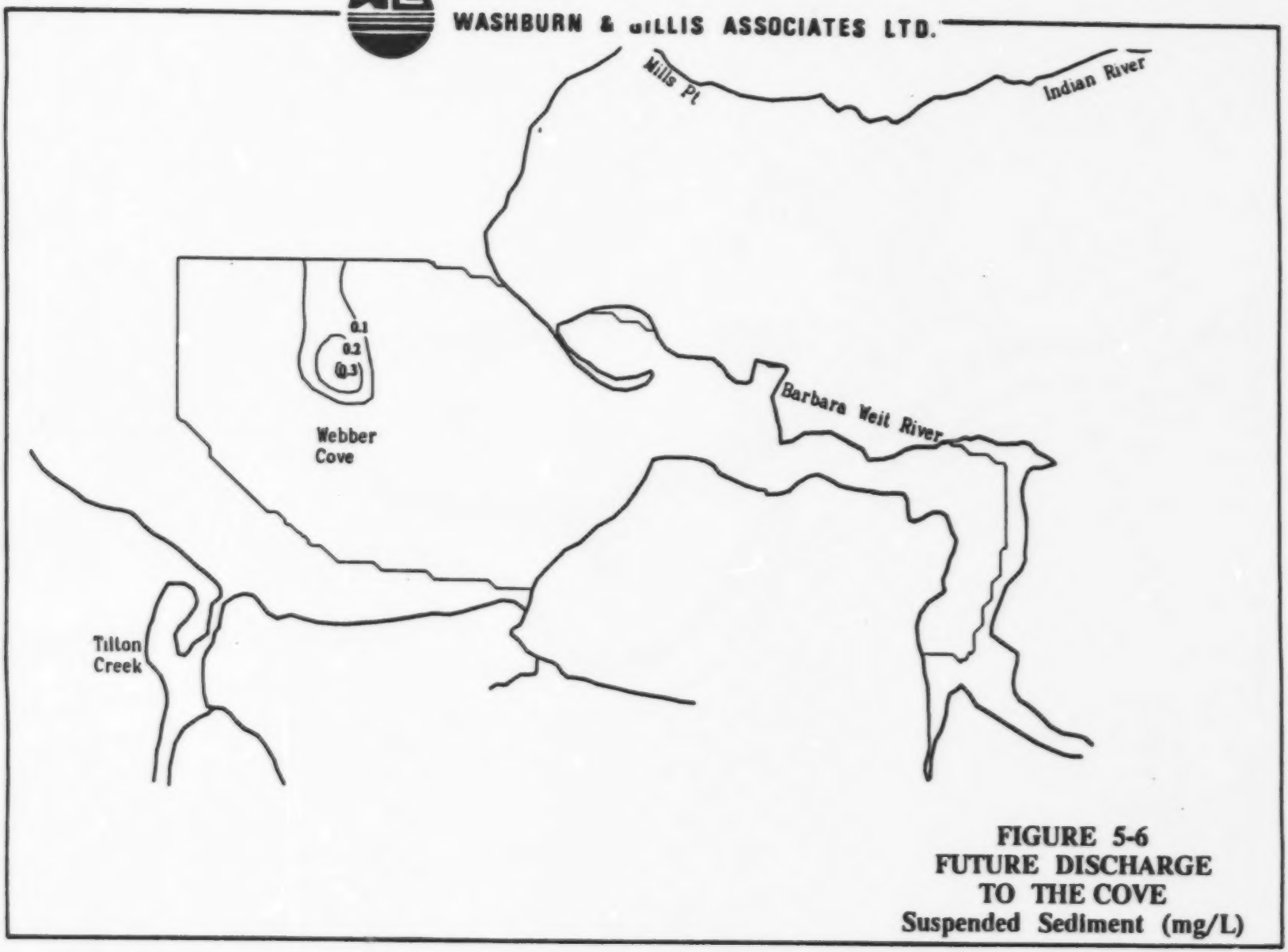

FIGURE 5-6
FUTURE DISCHARGE
TO THE COVE
Suspended Sediment (mg/L)

discharge contain more unknowns and uncertainties than do impacts related to the Estuary discharge. The possibility of accidental events add greater significance to these uncertainties. It is not known exactly how accidental ammonia, coliform, suspended solids, or BOD slug releases would affect the resources of Webber Cove. Based on these conclusions, it is our recommendation that the outfall from the proposed expanded WWTP be located in the Barbara Weit Estuary.